

**What is claimed is:**

1. A method for labeling synthesis of ketones, comprising:
  - 5 (a) providing a high pressure reaction chamber having a liquid inlet and a gas inlet in a bottom surface thereof,
  - (b) providing a solution to be labeled comprising a triflate, a boronic acid mixed with a transitional metal complex,
  - (c) introducing a carbon-isotope monoxide enriched gas-mixture into the reaction  
10 chamber of the UV reactor assembly via the gas inlet,
  - (d) introducing at high pressure said solution mixed with transition metal complex into the reaction chamber via the liquid inlet,
  - (e) waiting for a predetermined time while the labeling synthesis occur, and
  - (f) removing the labeled ketones from the reaction chamber.
- 15 2. A method of claim 1, wherein the carbon-isotope monoxide enriched gas-mixture is produced by a method comprising:
  - (a) providing carbon-isotope dioxide in a suitable carrier gas,
  - (b) converting carbon-isotope dioxide to carbon-isotope monoxide by introducing  
20 said gas mixture in a reactor device,
  - (c) trapping carbon-isotope monoxide in a carbon monoxide trapping device, wherein carbon-isotope monoxide is trapped but not said carrier gas, and
  - (d) releasing said trapped carbon-isotope monoxide from said trapping device in a well defined micro-plug, whereby a volume of carbon-isotope monoxide enriched  
25 gas-mixture is achieved.
3. A method of claim 1, wherein the carbon-isotope is  $^{11}\text{C}$ ,  $^{13}\text{C}$ , or  $^{14}\text{C}$ .
4. A method of claim 1, wherein the carbon-isotope is  $^{11}\text{C}$ .
- 30 5. A method of claim 1, wherein the step of introducing the solution to be labeled mixed with a transitional metal complex is performed using a pressure that is about

80 times higher than the pressure before the introduction, in order to maintain a pseudo one-phase system.

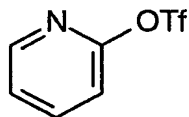
6. A method of claim 1, wherein the step of waiting a predetermined time comprises  
5 adjusting the temperature of the reaction chamber to enhance the labeling  
synthesis.

7. A method of claim 1, wherein the transitional metal complex is a palladium metal  
complex.

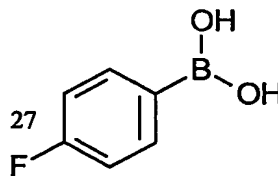
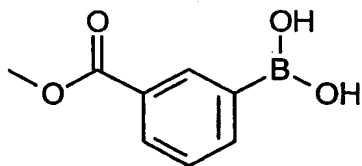
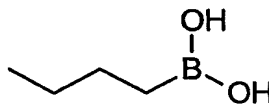
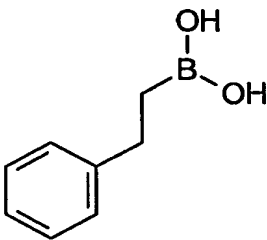
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8. A method of claim 1, wherein the triflate has a formula R1-OTf, wherein R1 is  
linear or cyclic alkyl or substituted alkyl, aryl or substituted aryl.

9. A method of claim 8, wherein R1 is selected from C<sub>6</sub>H<sub>5</sub>, 4-CH<sub>3</sub>O-C<sub>6</sub>H<sub>4</sub>, 4-CH<sub>3</sub>-  
15 C<sub>6</sub>H<sub>4</sub>, 4-NO<sub>2</sub>-C<sub>6</sub>H<sub>4</sub>, C<sub>10</sub>H<sub>7</sub> or



10. A method of claim 1, wherein the boronic acid has a formula a formula  
RB(OH)<sub>2</sub>, wherein R is linear or cyclic alkyl or substituted alkyl, aryl or substituted  
20 aryl.



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or theinyl.

12. A method of claim 1, wherein the solution to be labeled is further mixed with lithium bromide to facilitate the reaction.

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13. A labeled ketone synthesized according to a method of claim 1 having a formula of  $R_1-C^*O-R$ , wherein  $*$  is labeled carbon position, and  $R_1$  and  $R$  are independently linear or cyclic alkyl or substituted alkyl, aryl or substituted aryl.

10 14. A method of labeling synthesis of amines comprising:

- (a) synthesizing a labeled ketone of claim 13,
- (b) reductive aminate the labeled ketone with different amines in the presence of  $TiCl_4$  and  $NaBH_3CN$ .

15 15. A method claim 14, wherein the amines of step (b) having a formula  $R'R''NH$ , wherein  $R'$  is H, linear or cyclic alkyl or substituted alkyl, aryl or substituted aryl,  $R''$  is linear or cyclic alkyl or substituted alkyl, aryl or substituted aryl.

16. A labeled amine synthesized according to method 14 having a formula of

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25 wherein  $*$  is labeled carbon position, and  $R_1$  and  $R$  are independently linear or cyclic alkyl or substituted alkyl, aryl or substituted aryl,  $R'$  is H, linear or cyclic alkyl or substituted alkyl, aryl or substituted aryl,  $R''$  is linear or cyclic alkyl or substituted alkyl, aryl or substituted aryl.

30 17. A kit for PET study comprising a carbon-isotope labeled ketone of claim 13.

18. A kit for PET study comprising a carbon-isotope labeled ketone of claim 16.

19. A kit of claim 18, further comprising radioprotectant, antimicrobial preservative, pH-adjusting agent or filler.
- 5 20. A kit of claim 19, wherein the radioprotectant is selected from ascorbic acid, para-aminobenzoic acid, gentisic acid and salts thereof.
21. A kit of claim 19, wherein the antimicrobial preservative is selected from the parabens, benzyl alcohol, phenol, cresol, cetrimide and thiomersal.
- 10 22. A kit of claim 19, wherein the pH-adjusting agent is a pharmaceutically acceptable buffer or a pharmaceutically acceptable base, or mixtures thereof.
23. A kit of claim 19, wherein the filler is inorganic salts, water soluble sugars or  
15 sugar alcohols.